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Use of endophytic bacteria and fungi strains in plant protection and medicine

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ABSTRACT:
The paper present a review of the possible use of endophytic fungal and bacterial strains of microorganisms isolated from plants tissues which can be used in different biotechnologies in order to obtain some useful products for human medicine, agriculture and other domains. There were many isolation cases from plants roots, stems, and other parts .A considerable diversity was discovered in those community of microorganisms. The strains were tested for their inhibitory activity against plant and human pathogens. Some strains had antimicrobial properties, which can be use to have new antibiotics in the situation of new emerging pathogens and of many cases of resistance to the classical antibiotics. The endophytes are a source for antifungals too against plants and human pathogenic fungi. There are some strains which release compound with antivirus properties. Even against parasitic diseases some compounds produced by fungals and bacterial endophytic strains were identified. Some of them can inhibate in vitro culture of cancer cell lines, or have an immunomodulatory activity, to interfere with mechanism of neurodegenerative diseases, with inhibition of cholesterol accumulation. In plants protection, they can release substances against fungal pathogens of crops, or to release plants growth stimulating substances

Keywords: endophytes, pharmaceuticals, bioactive substances.

INTRODUCTION:

The soil microbiology is very complex and each species and each group has its own defined role to play in this habitat. As we already know, animals and plants and humans, have its inner microflora. Regarding our subject, the plants harbour on their surface and inside tissues and organs a very diverse microorganism community, bacteria and fungi, non-pathogenic, which are using the plants as habitat. Their function and relation with plants are still to discover and better understanding. In the same time we must think to a possible theory of pathogenesis and commensalism too that can bring some new explanation to such biological complex relationships. I consider the notion of endo-phyto-bionts used for non-parasitic and non-pathogenic microorganisms. The studies shown a complex community of fungi and bacteria.

Many isolation and experiments shown that these strains have characteristics which can be beneficial for humans. They can be use in different biotechnologies. Many fungal strains living as endophytes in some medicinal plants are able to release new compounds.

This can be used as pharmaceuticals [1]. Researches on the bioactive compounds elaborated by endophytic microorganisms were initiated in Brazil [2].

One of the elements from phytomicrobiota is the fungi including Ascomycota group from *Epicoccum* genus, [3], releasing compounds with antibiotic, anticancer and antidiabetic activity.

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The plants microbiota contains different taxonomical group of fungi like *Hyphomycetes* (*Acremonium, Cladosporium, Aspergillus, Curvularia*, and so on.), and *Coelomycetes* (*Colletotrichum fulcatum, Phoma, Lasidiploidea theobromae*) were isolated from *Urginea indica* [4]. In the same time, it looks like, the microflora of plants, endophytic fungi and bacteria vary upon plant host species and region of the globe (biogeographically). There are a huge diversity of such strains, in a study from Peru were discovered about 101 strains from which many *Ascomycetes*, some *Zygomycetes*, one *Basidiomycetes* and 14 bacterial strains [5]. They were tested for their antimicrobial activity against some pathogens. The fungal endophytes are producing bioactive compounds like alkaloids, flavonoids, polyketones, isocoumarins, phenols, terpenoids, and others which can be used in pharmaceutical (and agrochemical industry) with antiviral, antimicrobial, antimycotic, antidiabetic, anticancer and antimalarial and with immune-modulatory properties [6]. Other author [7] showed the same huge application opportunities of the endophytic microorganisms –production of enzymes, inhibitors of viruses proteases, anticancer compounds, antituberculosis substances (phomo-enamine, trichodermin and others) antifungal compounds (trichodermin, pestacin, cryptosporone), cholesterol inhibitors.

POSSIBLE USE OF THE ENDOPHYTIC STRAINS

A recent review about the endophytic fungi [8] showed that they can be in the near future an important source of new biological active molecules for pharmaceutical industry and other uses, about 51% being new for science. Its looks like that some of the plants substances are produced, in facts, by different endophytes. This can release substances which stimulate plants growth and health for example; some of them are releasing IAA and gibberellins [9]. Some endophytic bacteria are known to produce antibiotic, antiviral, antidiabetic or other type of bioactive molecules useful in biotech and pharmacy industry; some are ecomycins, pseudomycins munumbicins and xiamycins having antimycotic, antibacterial and even antiplasmodial activity [10].

1.1.Plant protection

Many fungal and bacterial endophytic strains have antagonistic activity against phytopathogens, and can support the plants in stress situations. Anyway, the association plant – endophytes is not a classical symbiosis, but include a kind of reciprocal cooperation, the plant influence the microbiota, and the endophytes influencing in different ways the host plant, maybe assuring some protection against phytopathogens [11]. Many isolated strains of fungi and actinomycetes, from roots and leaves of *Triticum durum*, showed an antagonistic activity against phytopathogens like *Fusarium*, and *Phytophtora* [12].

1.2. Production of pharmaceuticals

1.2.1..Antibiotics

The actinomycetes isolated had antagonistic activity against human bacteria pathogens (*Salmonella, Bacillus, Pseudomonas , Klebsiella, Staphylococcus, E. coli* and others) and yeasts (*Candida albicans*) which can be used for production of antibiotics [12].

Some new bioactive products were obtained from *Aspergilus terreus* strain MP15 isolated from the plant Swietenia *macrophylla* [13]. The extract contains 80% di n-octyl-phtalate and had antibiotic activity on food born bacteria (*Bacillus cereus, B subtilis, B spizizeni, Staphylococcus aureus*). *Diaporthe helianthi* isolated from *Luehea divaricate* produce a phenolic compound Tyrosol showing antibiotic

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activity against human pathogens and phytopathogens like *Xanthomonas* [14].

Antimicrobial activity against *Klebsiella pneumonia, Staphyllococcus aureus, Escherichia coli, Bacillus cereus, B.subtilis* was demostratred by *Nigrospora oryzae* strain isolated from *Ocinum sanctum* leaves [15]. From the same plant, were isolated fungi which are releasing antimicrobial compounds [16].

Another case is the helvolic acids derivatives produced by a *Fusarium* strain from *Ficus carica* leaves which have antimicrobial properties [17]. The endophytic fungus *Stemphilium radicinum* secondary metabolites had in vitro antibacterial activity tested on *E.coli* and *Staphylococcus aureus* [18]. Some endophytic bacterial strains from *Andrographys paniculata,* have antimicrobial activity against human and fish pathogens [19].

Other case is the *Streptomyces* strains obtained from *Monstera* release coronamycin-a peptide antibiotic with activity against human and plants pathogenic fungi, and had antimalarial effect too [20.

From the plants *Zataria multiflora, Achillea willemsi,* and *Caledula officinalis* were isolated strains of Gram negative bacilli and cocci, Gram negative cocci and G negative cocco-bacilli having antagonistic effects against nosocomial bacterial pathogenic strains *Acinetobacter baumannii, Staphylococcus aureus, Enterococcus faecalis, Pseudomonas aeruginosa* in vitro [21].

1.2.2. Antifungals

From *Cinnamomum malabatrum* leaves were isolated some endophytic strain, from which *Colletotrichum gloeosporioides* had an important antimicrobial activity. Their extract from fermentation broth inhibate not only the pathogenic bacteria, but the *Candida* yeasts too and has toxic effects against three cancer cell lines [22].

Many others endophytic strains showed antagonistic effects against *Candida albicans* [12]. Antimycotic substances released by endophytic fungi for example cryptocin, ecomycin, cryptocardin, pestaloside, and so on [23].

1.2.3.Anticancer

Some fungal strains isolated from plants, are able to produce compounds with anticancer activity for example as the substance produced by *Taxomyces andreanae* (from *Wollemia nobilis* and *Taxodium distichum*), camptothecin produced by endophytic fungi from *Mimusop elengi* [2]. *Pestalotiopsis microspora,* isolated from Taxus *chinensis* produce alpha pyrone derivatives with activity on two tumor cell lines [24].

1.2.4. Others

Some entophytic strains from fruits like *Theobroma grandiflorum, Ananas erectifolium* and *Sygydium cumini,* used terpenes as sole carbon sources nd can be used to its biotransformation for obtaining some new fragrances [25]. *Aspergillus fumigatus* strain CY 018, from *Cynodon dactylon* release fumiclavine and fumitremorgin which has vaso-relaxant effects and other related with cardio-vasculary system [26]. The same authors showed different substances from from the fungi *Eutypella scoparia* with antitubercular and anti Alzheimer disease effects (Huperzine A).

CONCLUSIONS

The fungal and bacterial endophytic strains are important components of the ecosystems. Their roles are still questionable and subject of new basic science researches.

Together with microflora of animal reign including humans we can refer as endobionts.

Some of them are able to release organic compounds, new molecules with practical application for mankind.

The released compounds have antimicrobial antimycotic, antiparasitic effects, and some of them effects in cancer and cardio vascular disorders, and possible many others.

The examples presented in this review paper, showed an ongoing new research domain, which is important from theoretical and practical point of view.

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